



Nuclear Hydrogen Initiative

Office of Nuclear Energy, Science and Technology
U. S. Department of Energy

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Goal of the Nuclear Hydrogen Initiative

The goal of the Nuclear Hydrogen Initiative is to demonstrate the economic commercial-scale production of hydrogen using nuclear energy by 2015, and thereby make available a large-scale, emission-free, domestic hydrogen production capability to fuel the approaching hydrogen economy.

Why Nuclear Hydrogen?

Hydrogen offers significant promise as a future energy technology, particularly in the transportation sector. The use of hydrogen in transportation will reduce U.S. dependence on foreign sources of petroleum and enhance our national security. Significant progress in hydrogen combustion engines and fuels cells is making transportation by hydrogen a reality. The primary challenge to using more hydrogen as part of the Nation's overall energy infrastructure is the cost associated with its production, storage and delivery. Hydrogen is the most common element in the universe and can be produced from readily available sources such as methane and water. However, existing hydrogen production methods are either inefficient or produce greenhouse gasses.

Recent research conducted under the Department's Nuclear Energy Research Initiative (NERI) indicates strong potential for the use of a thermochemical water splitting process to produce hydrogen. Use of very high temperature advanced reactors such as advanced gas-cooled or liquid metal-cooled reactors can provide the heat necessary for this process. In this manner, nuclear energy can produce hydrogen in very large quantities consistently over long periods of time without emitting greenhouse gases or other harmful air emissions.

Developing an Integrated Hydrogen Program

The President's hydrogen fuel initiative is a new research and development initiative focused on hydrogen to reverse America's growing dependence on foreign oil and expand the availability of clean, abundant energy. Hydrogen is produced today on an industrial scale in, the petrochemical industry by a

process of steam reforming, using natural gas as both source material and heat source. The recent NERI results holds out the promise of efficient hydrogen production through thermochemical "cracking" of water, using water and high-temperature heat as the process inputs. Several other processes are being piloted including high-temperature electrolysis of water.

Nuclear energy has the potential to play a significant role in these processes. Nuclear heat supplied through an intermediate heat exchanger to a hydrogen-producing thermochemical plant promises high efficiency and avoids the use of carbon fuels. In the nearer term, nuclear-generated, instead of carbon-based, heat and electricity can drive hydrogen production using the steam reforming or electrolysis processes at competitive prices.

The Office of Nuclear Energy, Science and Technology (NE) is conducting the Nuclear Hydrogen Initiative as part of the new hydrogen fuel initiative. A six-month nuclear hydrogen roadmap effort is underway to define objectives for nuclear-assisted production of hydrogen and identify the technology gaps and required research and development to assist deployment of the most promising technologies. NE is collaborating closely with the other DOE offices conducting hydrogen R&D - the Offices of Energy Efficiency and Renewable Energy (EE), Fossil Energy (FE), and Science (SC) - to avoid duplicative efforts, to ensure that their hydrogen R&D is complimentary, and to develop the production capability to fuel a hydrogen economy.

Supporting Research

Two R&D projects awarded through the NERI program in 1999 and 2000 found nuclear energy to be well suited for hydrogen production. These projects identified a number of advanced reactors that were designed to operate in temperature ranges compatible with several high-temperature "thermochemical" hydrogen production methods. The studies estimated that these processes could produce large amounts of hydrogen with high efficiency and low cost.

The Department has awarded three additional projects in this area as well as one International Nuclear Energy Research Initiative (I-NERI) research project. The Nuclear Hydrogen Initiative will build on this research.

Program Highlights

The Nuclear Hydrogen Initiative addresses the need for greater utilization of our energy resources by developing nuclear power as an integrated source of clean hydrogen which can supplant fossil fuels in our transportation system. Nuclear energy systems can be developed into a practical source of hydrogen that will reduce the environmental impacts of meeting growing hydrogen fuel demand.

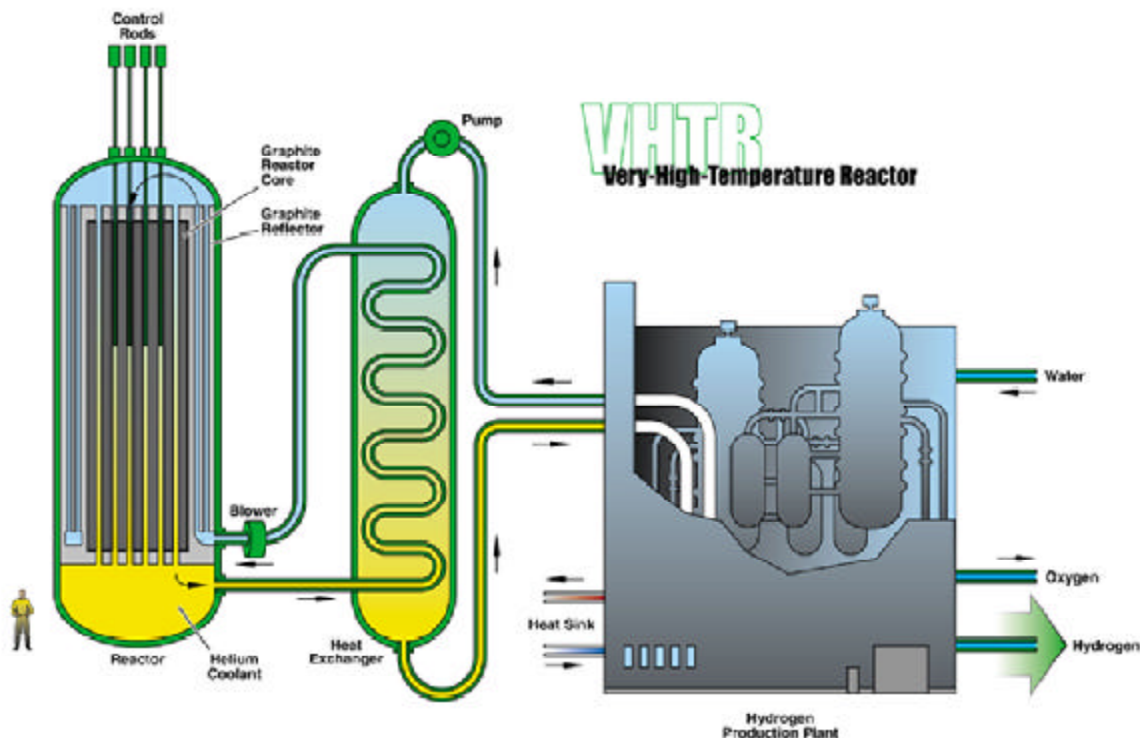
Program milestones include:

- FY 2003: Develop a Nuclear Hydrogen Technology Roadmap defining the R&D for the Nuclear Hydrogen Initiative.

- FY 2006: Complete a demonstration of a laboratory scale thermochemical hydrogen production system.
- FY 2010: Complete the design of a commercial scale nuclear hydrogen production system.
- FY 2015: Demonstrate commercial scale hydrogen production using heat from a nuclear reactor.

| Program Budget Nuclear Hydrogen (\$ in Millions) | | |
|--|---------------------------------|---------------------------|
| FY 2002 <u>Appropriation</u> | FY 2003 <u>Appropriation</u> | FY 2004 <u>Request</u> |
| \$0.0 | \$0.0* | \$4.0 |

** Nuclear Energy Technology budget includes \$2.0 M earmark for developing thermochemical production of hydrogen using the sulfur-iodine process.*



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